

C L A I M S

1. A transmission control method for a mechanical transmission, capable of transmitting an output of an internal combustion engine to wheels through a friction 5 clutch by performing automatic multistage speed change, comprising:

a step (a) of controlling an engine torque generated by the internal combustion engine in response to a request for a gear shift of the mechanical 10 transmission so that the value of a transfer torque of the friction clutch is 0 or near 0;

a step (b) of allowing the gear shift of the mechanical transmission when the engine torque is controlled so that the value of the transfer torque is 15 0 or near 0 in said step (a); and

a step (c) of disengaging and engaging gears with the clutch kept connected when the gear shift is allowed in said step (b).

2. A transmission control method for a mechanical 20 transmission according to claim 1, wherein said step (c) includes a sub-step (c1) of changing an engine revolution speed of the internal combustion engine after the gear disengagement is performed with the clutch kept connected and a sub-step (c2) of performing 25 the gear engagement for a gear stage after the gear shift with the clutch kept connected when the engine revolution speed is substantially synchronous with a gear revolution speed for the gear stage after the gear shift.

30 3. A transmission control method for a mechanical transmission according to claim 1 or 2, wherein the applicable mechanical transmission is configured so that said friction clutch can be automatically

connected and disconnected, and the step (c) includes automatically disconnecting the friction clutch to disengage and engage the gears if gear disengagement is not executed after a command for gear disengagement is 5 issued.

4. A transmission control method for a mechanical transmission according to claim 1, wherein said step (a) includes obtaining a changed engine torque such that the value of the transfer torque is 0 or near 0 in 10 accordance with a first motion equation for a range from the internal combustion engine to the friction clutch and a second motion equation for a range from the friction clutch to each wheel and a position on an axle shaft of a vehicle, indicating the changed engine 15 torque, and controlling the internal combustion engine so that the changed engine torque is generated.

5. A transmission control method for a mechanical transmission according to claim 4, wherein said first motion equation is transformed on condition that an 20 engine rotation angle acceleration on the axle shaft is equal to an axle shaft rotation angle acceleration on the axle shaft, and said step (a) includes obtaining the changed engine torque in accordance with the transformed first motion equation so that the value of 25 the transfer torque is 0.

6. A transmission control method for a mechanical transmission according to claim 4, wherein said second motion equation is transformed on condition that an engine rotation angle acceleration on the axle shaft is 30 equal to an axle shaft rotation angle acceleration on the axle shaft, and said step (a) includes obtaining the changed engine torque in accordance with the transformed second motion equation so that the value of

the transfer torque is 0.

7. A transmission control method for a mechanical transmission according to claim 4, wherein said friction clutch has a flywheel and a clutch plate

5 capable of being connected to and disconnected from the flywheel, a motion equation for a range from the internal combustion engine to the flywheel is used as the first motion equation, and a motion equation for a range from the clutch plate to each wheel and a

10 position on the axle shaft is used as the second motion equation.

8. A transmission control method for a mechanical transmission according to claim 4, wherein said step

(a) includes concluding that the value of the transfer

15 torque is 0 or near 0 after the lapse of a predetermined period since the indication of the changed engine torque.

9. A transmission control method for a mechanical transmission according to claim 1, wherein said

20 internal combustion engine includes a fuel injection pump unit having a control rack for adjusting a fuel injection quantity, and the step (a) includes controlling the control rack, thereby controlling the engine torque.

25 10. A transmission control method for a mechanical transmission according to claim 9, wherein said step (b) includes determining whether or not the value of the transfer torque is 0 or near 0 based on the position of the control rack.

30 11. A transmission control method for a mechanical transmission according to claim 2, wherein said internal combustion engine has an auxiliary brake, and said sub-step (c1) includes actuating the auxiliary

brake if the engine revolution speed of the internal combustion engine exceeds an upper limit value of a predetermined revolution speed range including a target engine revolution speed corresponding to the gear revolution speed.

5 12. A transmission control method for a mechanical transmission according to claim 2, wherein said sub-step (c1) includes correcting a target engine revolution speed corresponding to the gear revolution speed in accordance with the characteristics of the internal combustion engine.

10 13. A transmission control method for a mechanical transmission according to claim 1, wherein said step (c) includes issuing a command to restore the engine torque after the lapse of a predetermined period since the start of gear engagement when a gear shift from a high-speed stage to a low-speed stage of the mechanical transmission is required by the gear shift request.

15 14. A transmission control method for a mechanical transmission according to claim 2, wherein said internal combustion engine has an auxiliary brake, and said sub-step (c1) includes actuating the auxiliary brake if the engine revolution speed of the internal combustion engine exceeds an upper limit value of a predetermined revolution speed range including a target engine revolution speed corresponding to the gear revolution speed when a gear shift from a low-speed stage to a high-speed stage of the mechanical transmission is required by the gear shift request.

20 15. A transmission control apparatus for a mechanical transmission, capable of transmitting an output of an internal combustion engine to wheels

through a friction clutch by performing automatic multistage speed change, comprising:

engine torque control means for controlling an engine torque generated by the internal combustion

5 engine so that the value of a transfer torque of the friction clutch is 0 or near 0 when a gear shift of the mechanical transmission is required;

gear shift allowing means for allowing the gear shift of the mechanical transmission when the engine

10 torque is controlled by the engine torque control means so that the value of the transfer torque is 0 or near 0; and

gear shift executing means for disengaging and engaging gears with the clutch kept connected when the

15 gear shift is allowed by the gear shift allowing means.

16. A transmission control apparatus for a mechanical transmission according to claim 15, which further comprises engine revolution speed detecting means for detecting an engine revolution speed of the

20 internal combustion engine and gear revolution speed detecting means for detecting a gear revolution speed for a gear stage after the gear shift, and wherein said gear shift executing means changes the engine revolution speed of the internal combustion engine

25 after the gear disengagement is performed with the clutch kept connected and performs the gear engagement for the gear stage after the gear shift with the clutch kept connected when the engine revolution speed is substantially synchronous with the gear revolution

30 speed for the gear stage after the gear shift.

17. A transmission control apparatus for a mechanical transmission according to claim 15 or 16, wherein said friction clutch is configured to be able

to be automatically connected and disconnected, and the gear shift executing means automatically disconnects the friction clutch to disengage and engage the gears if gear disengagement is not executed after a command 5 for gear disengagement is issued.

18. A transmission control apparatus for a mechanical transmission according to claim 15, whereinsaid friction clutch has a flywheel and a clutch plate capable of being connected to and disconnected 10 from the flywheel, and said engine torque control means obtains a changed engine torque such that the value of the transfer torque is 0 or near 0 in accordance with a first motion equation for a range from the internal combustion engine to the flywheel and a second motion 15 equation for a range from the friction clutch to each wheel and a position on an axle shaft of a vehicle and controls the internal combustion engine so that the changed engine torque is generated.

19. A transmission control apparatus for a mechanical transmission according to claim 15, whereinsaid internal combustion engine includes a fuel injection pump unit having a control rack for adjusting a fuel injection quantity, and said engine torque control means controls the control rack, thereby 25 controlling the engine torque.

20. A transmission control method for a mechanical transmission according to claim 16, wherein said internal combustion engine has an auxiliary brake, and said gear shift executing means actuates the auxiliary brake if the engine revolution speed of the 30 internal combustion engine exceeds an upper limit value of a predetermined revolution speed range including a target engine revolution speed corresponding to the

gear revolution speed.